

AD-A240 873

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2. REPORT DATE Vol. 39. No. 1; 1991		3. REPORT TYPE AND DATE COVERED Journal Article 1991	
4. TITLE AND SUBTITLE An Evaluation of Instructional Systems Development in the Navy		5. FUNDING NUMBERS None	
6. AUTHOR(S) Barbara Taylor, John Ellis			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Navy Personnel Research and Development Center San Diego, California 92152-6800		8. PERFORMING ORGANIZATION JA-91-06	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) SEP 25 1991		10. SPONSORING/MONITORING Education and Training Research and Development, 39(1), pp. 93-103, 1991	
11. SUPPLEMENTARY NOTES			
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.		12b. DISTRIBUTION CODE A	
13. ABSTRACT (Maximum 200 words) One hundred Navy enlisted courses were evaluated to determine how instructional system development (ISD) has been applied in technical training. We examined the following components of the courses; (1) classroom objectives and test items and (2) classroom presentations for knowledge objectives. The major findings are that (1) 56 percent of the 1945 knowledge objectives examined were inappropriate for the course training goal and future job requirements, (2) 49 percent of the objectives were not tested, (3) 48 percent of all test items did not match related objectives, (4) 38 percent of all test items were inappropriate, (5) practice was incomplete or not present for almost one-half of the presentations, and (6) many instructional strategies proven to be effective in civilian classrooms were not utilized.			
14. SUBJECT TERMS instructional system development; ISD; classroom instruction; evaluation		15. NUMBER OF PAGES 11	
		16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UNLIMITED

91-11457

An Evaluation of Instructional Systems Development in the Navy

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Availability Codes	
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□ Since the 1960s, the military and much of the civilian business community have used a systematic approach to curriculum development. This approach, often called Instructional Systems Development (ISD), grew out of the "systems analysis" approach to problem solving that became popular after World War II (Kearsley, 1984). Since then, hundreds of manuals have been published which provide instruction on how to design and develop instruction (Andrews & Goodson, 1980; Montemerlo & Tennyson, 1976). Although these manuals differ in many ways, they all share the same basic components (Dick & Carey, 1985). The systems approach to instructional development is oriented toward job performance and concerned with the identification of training requirements based on job data obtained from the field. From this job analysis, learning objectives are formulated with corresponding tests which are used to assess trainees' progress toward meeting the objectives. ISD procedures also attempt to prescribe optimal instructional strategies, media, and sequencing for various types of training activities. In short, ISD is an attempt to ensure that training is job relevant, cost effective, and efficient (Montague & Wulfeck, 1986).

Over the past fifteen years, the Navy has moved steadily toward more and more detailed ISD guidelines. These very specific procedures are almost "cookbook" in nature and are designed for the relatively inexperienced

curriculum developer. While many of the Navy's courses are originally developed by contractors (who also follow the ISD guidelines), the task of revising and managing the courses falls to Navy personnel assigned to the various training commands. The Navy teaches over 7,000 courses and has within its training commands a limited number of civilian education specialists who monitor the development and management of training. Hence, Navy instructors with subject matter expertise are primarily responsible for revising, developing, and maintaining training materials, yet frequently these personnel have had limited or no experience in curriculum development. Thus, the intent of the Navy's specific guidelines is to provide enough information to allow nonexperts in training to develop adequate instruction with minimal outside assistance.

The work reported in this article is part of an ongoing research effort on quality control of the instructional development process. The goal of this project was to evaluate how effectively the procedures and principles of the systems approach have been applied in the development and maintenance of Navy technical training; that is, to determine whether the Navy's guidelines have resulted in the provision of adequate instruction.

BACKGROUND

One of the military's first attempts to proceduralize ISD was *The Interservice Procedures for Instructional Systems Development* (Branson et al., 1975). This manual, developed under contract by Florida State University and published by the Army and Navy, presented an ISD model based on five phases. Analysis, Design, Development, Implementation, and Control. The intent of the manual was to provide sufficient guidance to nonexperts in ISD to allow them to adequately design, develop, and manage training.

Since 1975 there have been additional manuals providing even more detailed guidance on the implementation of ISD. For example, the *Handbook for Training Materials Development* (DOD-HNDK-292) (Department of the Navy, 1986) provides a very rigid set of procedures in a

500-page two-volume manual. There are over 50 complex, multipage flowcharts that guide the user through the ISD process. This is just one of several documents currently used in the military to guide the development process. In a study conducted in the late 1970s, Vineberg and Joyner (1980) reviewed the ISD methodologies and practices in the Army, Navy, Marine Corps, and Air Force. They evaluated 57 courses at 33 different organizations to determine the effectiveness of the various ISD procedures and their application within the four services. They found that the guidelines or ISD manuals did not ensure adequate implementation of ISD. Often training did not meet job requirements: training objectives often ignored task requirements and tests were developed without regard to training objectives. In fact, Vineberg and Joyner found that there was evidence to suggest that "objectives are often prepared after the fact and are derived from training content rather than used to generate it." (page xii). This practice runs directly counter to the ISD process. Similar problems have been found in other broad reviews (Hodak, Middleton, & Rankin, 1979; Middleton, Zajkowski, & Aagard, 1979) as well as in evaluations of specific courses (Ellis, 1985; Lockhart, Sturges, VanMatre, & Zachai, 1979; Montague, Ellis, & Wulfeck, 1983; Stern & Fredericks, 1982).

The work reported in this article builds on these studies. An extensive evaluation of Navy classroom training was conducted to determine how effectively the systems approach is being applied within the Navy. (Note that different branches of the Navy use somewhat different development guidelines and manuals.) The study included evaluation of segments of approximately one week's duration from 100 courses for enlisted personnel that ranged from the basic entry-level course to the more sophisticated advanced training course. For each course, a representative sample of the course objectives, test items, and instructional presentations were reviewed. The evaluation was of classroom training rather than laboratory instruction, and the focus was on objectives that were associated with written tests rather than performance tests. Objectives, test items, and presentations were evaluated to determine the following:

1. appropriateness of the objectives, test items, and presentation for the overall course training goal (which is based on the job requirements);
2. consistency of objectives and test items (do the test items match the objectives?);
3. adequacy of the test items (are the test items properly constructed?);
4. consistency of the classroom presentation and the training objectives (does the presentation contain the right combination of presentation components?);
5. adequacy of the classroom presentation (is the information presented clearly stated and job oriented?);
6. instructor and instructional effectiveness.

The Course Evaluation System (CES) (Ellis, Knirk, Taylor, & McDonald, 1987) was the primary tool for evaluating the 100 Navy courses. This evaluation model is based on research, techniques, and procedures developed by Bloom (1984); Ellis (1985); Ellis, Wulfec, and Fredericks (1979); Merrill (1983); Merrill, Reigeluth, and Faust (1979); and Montague, Ellis, and Wulfec (1983). The basic CES methodology has been empirically validated for validity and reliability in a number of research and practical applications (e.g., Ellis, 1985; Ellis, Wulfec, Merrill, Wood, & Baker, 1979; Montague, Ellis, & Wulfec, 1983; Stern & Fredericks, 1982; Taylor, Ellis, & Baldwin 1988). While the CES has been validated, it should be noted that it is designed to be applied to objectives-based training that has been developed using the ISD process. Further, the CES evaluation criteria were distilled from the work cited above and the explicit goals contained in many ISD models (e.g., Branson et al., 1975). The following section provides details on the CES and how it was applied.

METHOD

Course Sampling

One hundred enlisted Navy courses were selected for evaluation. Courses were selected to be a representative distribution of the total number of enlisted training courses by war-

fare community (surface, air, and subsurface) as well as type of school (apprentice, advanced, and fleet). There were some constraints in the sampling process. In order to minimize travel, most of the courses selected were conducted in the San Diego area, although a variety of commands and squadrons were included. A total of 16 commands and squadrons, three outside the San Diego area, were included in the evaluation.

The Course Evaluation System Process

Because of time constraints, entire courses could not be evaluated. So, after an initial interview with the course instructors and managers, a representative sample of each course (approximately one week of instruction) was selected for evaluation, based on the recommendations of the course personnel. The evaluation of the objectives, test items, and classroom presentations was a six-step process.

Step 1: Classify Objectives

Classifying objectives makes them easier to evaluate for appropriateness and to match with test items. It also facilitates the evaluation of the instructional presentation. An objectives listing was obtained for each course and the objectives related to the sample of instruction selected for evaluation were classified. The CES has a classification scheme that is a simplified version of those developed for Merrill's Component Display Theory (CDT) (Merrill, 1983) and the Navy's Instructional Quality Inventory (IQI) (Montague, Ellis, & Wulfec, 1983). These schemes were simplified to be better aligned with the type of training occurring in Navy classrooms and to facilitate the classification process.

In the CES there are three categories of objectives that are associated with written (paper and pencil) tests: *Remember*, *Locate*, and *Mental Skills*. *Remember* objectives require the student to recall or recognize specific information, such as basic facts, steps of procedures, or formulas for mathematical computations. For *Locate* objectives, the student must be able to find information in technical manuals or instructions. The student would not be required

to remember equipment specifications or maintenance procedures, but would need to know how to locate those specifications and procedures in a technical manual. For *Mental Skills* objectives, the student must solve problems using rules, concepts, and principles. For example, a student might be required to classify a series of sonar scope displays, solve mathematical problems, or predict the effect of fluid contamination on aircraft performance.

The relationship of these three categories of objectives to the task and content categories from CDT and the IQI is as follows: the Remember category corresponds to remember-fact, procedure, concept, and principle categories; the Locate category corresponds to the use-procedure category; and the Mental Skills category corresponds to the use-principle and use-concept categories. This entire scheme is described in detail in the CES.

Step 2: Match Objectives and Test Items

Test items were obtained for the objectives classified. Test items were taken from course module and end-of-course exams. Items from instructor-developed quizzes were not included.

Learning objectives are made up of three main components: the conditions under which the task is to be performed, the action or behavior that the trainee is to exhibit, and the standard by which performance is to be judged. To match objectives and test items, each test item was evaluated to see whether the conditions, action, and standard specified by the objective were incorporated in the test item or items associated with it. In other words, were the students being tested the way the objective stated they would be tested?

For Remember objectives, the actions and conditions had to be an exact match. That is, if the objective required the student to be able to *recall* from memory, then a corresponding multiple-choice test item would not match because it requires only that the student be able to *recognize* the correct answer. For example, if the objective is that the student "state the definition of Minimum Force as it appears in the Master-Air-Arms Manual," and it has a cor-

responding multiple-choice test item, then the actions and conditions do not match. The actions do not match because the objective requires the student to state the definition or recall it from memory, but the test item allows the student to select the correct definition. The conditions (givens) do not match because the test item provides a list of possible answers that are not specified in the objective.

Finally, the number of objectives for which there were no matching test item(s) were recorded. According to most ISD guidelines, there should be at least one test item for each objective. Note that in many courses not all objectives are actually tested because of time constraints. However, if there was a test item (usually in a test item bank) for an untested objective, it was counted as a match.

Step 3: Identify Course Training Goal

After objectives were classified and linked to test items, one or more senior instructors were interviewed at the school to determine the overall course training goal so that judgments could be made as to objective and test appropriateness. Instructors were asked to identify the course training goal from the following:

- Heavily Supervised On-the-Job Training (OJT). The student should be generally familiar with terminology, technical documentation, and duties required on the job.
- Minimally Supervised OJT. The student should receive enough hands-on training so that upon graduation he or she will be able to perform the job with very little supervision.
- Skilled Performer. The student should receive enough hands-on training so that upon graduation from the course, he or she will be able to perform the task with no assistance from a supervisor.

Clearly, the course training goal has important implications for course objectives and test items. Objectives and test items should contain more rigorous requirements as one moves from the Heavily Supervised OJT to the Minimally Supervised and Skilled Performer levels

Step 4: Determine Appropriateness of Each Objective

The conditions, action, and standard of each learning objective were rated for appropriateness for the course training goal and future job requirements. All ratings were "yes" or "no" judgments. An objective is considered to be inappropriate in any one of its parts—conditions, action, or standard—is inappropriate. An example of an objective that would be rated as inappropriate is one that requires students to memorize information or procedures from technical or reference manuals used on the job. In this case the *action* is inappropriate because the student is required to memorize information rather than locate it, and the *conditions* is inappropriate because students are not given the technical or reference manual in the classroom.

A second criterion for rating objective appropriateness concerns the memory requirements of the job. If critical information must be memorized for on-the-job performance, and the objective requires only that the student recognize that information, then the conditions and actions would be rated as inappropriate. For example, the objective "The student will be able to identify from a list the safety precautions to be observed when performing maintenance on the aircraft" would be rated as inappropriate. The action is inappropriate because the student should be required to state the precautions from memory, and the condition is inappropriate because the student is given a list of possible answers from which to choose, which would never happen on the job.

A third reason for an inappropriate rating concerns the objective standards. For example, if the course training goal was identified as Skilled Performer but the standard specified in the objectives for course tests was 75%, then the objective's *standard* would be rated as inappropriate—a 75% standard is too low to guarantee a person could perform duties at the Skilled Performer level.

In addition to rating each objective for appropriateness, at least two course instructors were asked to rate each objective as to its importance to the job the students were being

trained to do. Instructors were asked to rate each objective as "essential," "nice to know," or "nonessential" while keeping the job requirements in mind.

Step 5: Determine Appropriateness and Adequacy of Test Items

Here appropriateness refers to how well the test item conditions, action, and standard match the overall course goal as determined in Step 3. The procedure and criteria for rating test item appropriateness were the same as those for rating objective appropriateness.

Test item adequacy refers to how well the item is constructed; that is, were the guidelines for test construction adhered to? For example, for a fill-in-the-blank item, is it worded so that only one word or phrase could correctly complete the sentence? Are there grammatical or other cues to the correct answer? Is there only one blank in a single item? For multiple-choice tests, are all choices believable? For a complete set of adequacy criteria, see the CES (Ellis et al., 1987), *Handbook for Testing in Navy Schools* (Ellis & Wulfeck, 1982), and Ellis & Wulfeck (1986).

Step 6: Evaluate Classroom Presentation

At least 30 minutes of classroom instruction associated with knowledge-type objectives (Remember, Locate, Mental Skills) for each of the 100 courses were observed. First, the *consistency* and the *adequacy* of the presentation were evaluated using checklists from the CES (Ellis et al., 1987).

In order for a presentation to be *consistent*, it must contain an appropriate combination of presentation parts or components required for the type of objective of the training. There are four possible components—statements, practice remembering with feedback, examples, and practice using with feedback—described as follows:

1. *Statements* present essential information needed by the student to master the objective. For example, a statement for a Remember objective that requires the student

to know the part names of a lathe could involve the instructor naming the parts on a diagram or on the actual equipment in front of the class. For a Locate objective that requires the student to find information in a manual, the instructor should state or visually present the steps of the procedure one goes through to find things in a manual.

2. *Practice remembering with feedback* provides an opportunity for the students test their ability by recalling or recognizing specific information presented in the statement.
3. *Examples* demonstrate the task to be performed. For example, the instructor might demonstrate looking things up in a manual or filling out paperwork.
4. *Practice using with feedback* gives students an opportunity to perform the task and receive corrective feedback.

Not all presentation components are required for each type of objective. Table 1 provides the components required for the three types of knowledge objectives.

Adequacy refers to a number of design principles that promote student learning. In rating the adequacy of the presentations, the organization and format of materials were evaluated as well as whether additional explanation was provided to help students learn and retain the information. Specifically, each presentation component was rated for being:

1. *Separated*. Is the component separated from the rest of the instruction? Students need

to be able to find important information.

2. *Identified*. Is the component identified so that students know what they are looking at?
3. *Clearly stated*. Is the component clearly stated so that the student can understand it?

Presentations were also rated for the presence or absence of "helps"—Does the component contain something to help the student better understand?—and for being "job oriented"—Is the component oriented toward job performance?

To summarize, a *consistent* presentation contains the presentation components required for the type of objective(s), and an *adequate* presentation presents the component information in the most effective and efficient manner.

After the consistency and adequacy evaluation, the overall effectiveness of the classroom presentation was evaluated using a CES checklist that rated (1) instructor behavior, (2) media and materials, (3) the classroom environment, and (4) student behavior in the classroom. The overall effectiveness checklist contained a series of yes/no questions related to presentation effectiveness. For example, instructors were evaluated as to whether they (1) motivated students by explaining why the content should be learned, (2) told students how they would be tested, (3) monitored students' progress, and (4) ensured students were actively involved.

TABLE 1 □ Presentation Components Required for Each Objective Type

OBJECTIVE TYPE	Statement	REQUIRED PRESENTATION COMPONENTS		
		<i>Practice Remembering with Feedback</i>	<i>Examples</i>	<i>Practice Using with Feedback</i>
Remember	Required	Required	Not required	Not required
Locate	Required if no recent Remember objective	Required if no recent Remember objective	Required	Required
Mental Skills	Required if no recent Remember objective or aid	Required if no recent Remember objective or aid	Required with variety of examples	Required with variety of practice problems

RESULTS AND DISCUSSION

Objective Classification

Of the 1,945 knowledge objectives classified, 46 percent were Remember objectives ($n = 888$), 52 percent were Locate objectives ($n = 1,004$), and 2 percent were Mental Skills objectives ($n = 53$). The low percentage of Mental Skills Objectives is consistent with a previous study that classified over 30,000 objectives (Wetzel, VanKekerix, & Wulfbeck, 1987). This finding reflects the routine procedural nature of the majority of Navy jobs.

Objective and Test Item Evaluation

Table 2 provides the results of the objective and test item evaluation. A total of 1,945 objectives and 2,734 test items were evaluated.

Objective Not Appropriate

An objective was considered to be inappropriate if any one of its parts (conditions, action, or standard) was inappropriate. Table 3 shows that over half (56 percent) of the objectives rated were inappropriate. While some objective conditions and actions were found to be inappropriate for the reasons described in the Method section of this article, the majority of objectives were rated as inappropriate because of problems with the standard. Table 3 shows that 51 percent of the objectives did not have appropriate standards. This was because often standards were too low to support the course training goal. The cause of this is that many of the Navy documents that

TABLE 2 ☐ Objective and Test Item Evaluation Results

<i>Objectives (n = 1,945)</i>	
Objective Not Appropriate	56%
Conditions Not Appropriate	14%
Standards Not Appropriate	51%
Actions Not Appropriate	8%
Objective Not Essential	8%
Objective Not Tested	49%
<i>Test Items (n = 2,734)</i>	
Test Item Does Not Match Objective	48%
Conditions Do Not Match	38%
Standards Do Not Match	6%
Actions Do Not Match	41%
Test Item Not Adequate	7%
Test Item Not Appropriate	38%

Note: Inappropriate objectives or test items may have more than one inappropriate part.

guide the development of instruction and tests arbitrarily set passing standards. For example, the *Training Specifications Manual* (NAMT-GINST.P1540.2G) specifies that a passing grade on a written test should be between 63 and 75% (although it does allow for individual test items to require 100% accuracy). When applied to courses with a training goal at the Minimally Supervised level, this standard was considered too low because the Minimally Supervised job incumbent needs a higher level of job knowledge to perform effectively. This problem occurred in over 30 of the courses reviewed.

Table 3 highlights this relationship between training goals and inappropriate objectives. A significant difference was found among training goals for the frequency of inappropriate objectives ($\chi^2 = 311.50, p < .01$). The higher the training goal, the more likely that the ob-

TABLE 3 ☐ Inappropriate Objective Components by Training Goal

TRAINING GOAL	INAPPROPRIATE OBJECTIVE COMPONENT		
	<i>Standard</i>	<i>Action</i>	<i>Condition</i>
Skilled Performer $n = 262$	87%	13%	34%
Minimally Supervised $n = 1063$	70%	10%	9%
Heavily Supervised $n = 620$	3%	5%	15%

jective standard would be rated as inappropriate. One possible explanation for this is that often the *minimum* standard established by training development documents command becomes the *only* standard. Test standards are not always adjusted upward to meet the demands of courses with higher training goals.

Objective Not Essential

A very low percentage of objectives were rated by instructors as nonessential. Most of the objectives were identified as either essential or "nice to know." In other words, the instructors felt that most of the objectives should be retained because they were either necessary or provided motivational information to the student.

Objective Not Tested

Almost half (49 percent) of all objectives that we reviewed were not tested, even though the vast majority of them were considered essential by the instructors. In some cases this occurred because the courses had a large number of very specific objectives. In these courses it was common to review a one-hour lesson that had over a dozen enabling or supporting objectives. For example, when a terminal (main) objective for a lesson required the student to locate equipment information in a manual, several enabling objectives required the student to describe individual dials and knobs. Time constraints made it impossible for all of these objectives to be tested. However, even courses with fewer and more broadly stated objectives had large percentages of untested objectives. Further, even when a broadly stated objective had an associated test item, it often related only to a portion of the objective.

Test Item Does Not Match Objective

Almost half (45 percent) of all test items did not match the corresponding objective. In other words, at least one objective component (action, condition, or standard) did not match the related test item. In most cases, when the conditions and actions did not match, the ob-

jective required the student to *recall* the correct answer and the test item required the student to *recognize* the correct answer.

There were also a number of courses in which the test item standards did not match related objective standards. This usually occurred when the objective stated that a student must correctly answer a certain number of test items corresponding to that objective. Objective and test standards did not match because test items for individual objectives were not scored separately. That is, a student could pass the test based on the total score even though he or she failed to answer the correct number of test items related to an individual objective.

Test Item Not Adequate or Not Appropriate

Table 2 also presents the findings for inadequate and inappropriate test items. There were very few inadequate test items (although the fact that the researchers were not subject matter experts and therefore were unable to judge whether the alternative choices for multiple-choice items were realistic could have resulted in less items being classified as inadequate).

Over a third of the test items were rated as inappropriate. The most frequent reason for this was that the standard was considered too low to support the training goal of the course. This problem is the result of inappropriate standards for the related objectives.

Classroom Presentation Evaluation

Presentation Consistency

Most of the presentations associated with knowledge objectives were consistent. In other words, they contained the presentation components required for the particular type of objective. However, we found that in almost half (46 percent) of the presentations associated with Remember objectives, the "practice remembering with feedback" component was either incomplete or absent altogether. Further, in a quarter of the presentations for Locate objectives, both the statement and the

"practice remembering with feedback" components were either incomplete or absent.

Presentation Adequacy

In general, the presentations observed were adequate. The majority of the objective components met the adequacy criteria. Approximately 67 percent of them were adequate on the separated, identified, and clearly stated criteria. These criteria provide students with information about where they are in the instructional process. This type of "road map" is important and can affect student learning and retention. In addition, over 70 percent of the components contained helps, and over 80 percent of them were rated as job oriented.

Effective Checklist Results

The majority of the instructors we observed delivered the instruction in an effective manner and actively involved the students in the learning process by using proper questioning techniques (75 percent of the courses observed) and checking student comprehension (75 percent of the courses observed). However, the evaluation revealed that many instructional practices that have been shown to have a positive effect on student learning in the civilian environment are not being utilized within military training. These include peer instruction (11 percent of the courses observed), advance organizers (34 percent of the courses observed), and use of external rewards (6 percent of the courses observed).

As is probably the case with most civilian and military courses, the typical classrooms observed during the evaluations could have been classrooms of 25 years ago. The media used almost always consisted of chalkboards and occasionally overhead transparencies of tables or diagrams from a technical manual. The benefits of modern training technology have not reached the Navy classroom.

GENERAL DISCUSSION

In summary, for the objective and test item evaluation it was found that (1) a majority (56

percent) of the 1,945 knowledge objectives examined were inappropriate for the course training goal and future job requirements; (2) almost half (49 percent) of the objectives were not tested; (3) about half (48 percent) of all test items did not match related objectives; (4) over a third (38 percent) of all test items were considered inappropriate; and (5) the majority of test items (93 percent) were adequately constructed.

For the presentation evaluation it was found that (1) delivery of most presentations was adequate and consistent with the type of objective being taught; (2) practice for almost half of the presentations was incomplete or not present; (3) many instructional strategies proven to be effective in civilian classrooms were not utilized; and (4) use of media in the classroom was generally limited to chalkboards and overhead transparencies.

The problems identified in this study are not unique to the military. Any time one attempts to implement a process as complex as ISD, there are potential problems. Many of the problems found were primarily due to objectives and tests that were written without regard to the level of knowledge required to support future job requirements. This accounts for the rather overwhelming number of objectives and test items that were classified as inappropriate. The problem is easy to recognize, but may be difficult to fix. The notion of training goals and related passing test scores is not foreign to those who develop instruction. However, there is an institutional bias toward universal passing scores and multiple-choice test items that is extremely difficult to overcome. This is true in civilian as well as military education and training. Nickerson (1989) recently recognized this problem, but also emphasized that the solution is not easy or, in some cases (e.g., mental skills, thinking), not obvious. As a first step in military training development, ISD guidelines should eliminate the notion of global passing scores that are applied across large numbers of courses, and instead let passing scores be set for each individual course based on job requirements.

The problems with untested objectives and with objectives that are not well matched to

test items may be difficult to solve for the same reasons. Here, too, as a first step the instructional development guidelines should be revised to promote the development of more job-related objectives and test items. There should be less emphasis on rote memorization and more emphasis on comprehension and familiarization with technical documentation. Guidelines should provide instruction on how to write objectives and test items to ensure that all objectives get tested and that the test items are written to match the objectives.

The lack of sophisticated media is also a difficult problem. Most instructors used the chalkboard and transparencies containing information from technical manuals. Many of the presentations could have been enhanced with other media to improve motivation, increase attention, and provide better quality (e.g., more accurate) training. However, current budget limitations make it difficult to upgrade classrooms. This problem may diminish as all types of media become more affordable.

Instructional practices that have been shown to have a positive effect on learning within the civilian community, such as peer instruction and systematic assessment of student progress, were not utilized in the classes that were observed in this study. These practices should be applied in Navy classrooms on a trial basis to see how well they work. However, the mechanisms for doing this are not well established, and there is an institutional resistance to substantial changes in the way instruction is conducted (Semb, Ellis, Montague, & Wulfeck, 1990).

One important area in which there were relatively few problems was the classroom instructor. The Navy's instructor training and subsequent certification process (accomplished in the schools) is producing highly qualified instructors. The instruction observed was well presented, the instructors were enthusiastic, and students were attentive. The major deficiency in the classrooms is the lack of time given to allow students to practice what they must learn. Investing in practice yields high return, as it increases proficiency more than any other activity. Managers should ensure

that their curriculum development guidelines stress the importance of practice in the classroom.

Implications for Instructional Designers

Melvin Montemerlo (1979) pointed out that one of the dangers of proceduralizing the ISD process is that designers and developers often tend to lose sight of the whole process. Course designers frequently focus on the present development step without thinking about the final product. Many of the problems found within the Navy's implementation of ISD support this observation. Problems such as inappropriate course standards, inappropriate memorization requirements, inadequate testing, and lack of practice occur when the course developer fails to keep focus on the ultimate course goal: to train students to perform a specific job. Thus, standards get set that fail to meet job requirements and students do not practice enough to have sufficient job knowledge or to learn at a level needed on the job. To develop effective instruction, course designers must focus continually on the relationship between the components of the course (i.e., objectives, test items, and instructional presentation) and the requirements of the job the student will be expected to perform upon graduation. □

REFERENCES

- Andrews, D. H., & Goodson, L. A. (1980). A comparative analysis of models of instructional design. *Journal of Instructional Development*, 3(4), 2-16.
- Bloom, B. S. (1984). The 2 sigma problem: The search for methods of group instruction as effective as one-to-one tutoring. *Educational Researcher*, 13(6), 4-16.
- Branson, R. K., Rayner, G. T., Cox, J. G., Furman, J. P., King, F. J., & Harnum, W. H. (1975). *Interservice procedures for instructional systems design* (Tech. Rep., NAVEDTRA 106A). Pensacola, FL: Navy Education and Training Command.
- Department of the Navy. (1986). *Military handbook for training materials development*. (DOD-HNDK-292). Washington, D.C.: Author.
- Dick, W., & Carey, L. (1985). *The systematic design of instruction* (2nd ed.). Glenview, IL: Scott, Foresman.

- Ellis, J. A. (1985). *Review of the air intercept controller basic course* (NPRDC TR 85-22). San Diego: Navy Personnel Research and Development Center (AD A153-964).
- Ellis, J. A., Knirk, F. G., Taylor, B. E., & McDonald, B. A. (1987). *The course evaluation system* (NPRDC TR 87-19). San Diego: Navy Personnel Research and Development Center (AD A122-479).
- Ellis, J., & Wulfek, W. (1982, October). *Handbook for testing in Navy schools* (NPRDC SR 83-2). San Diego, CA: Navy Personnel Research and Development Center (AD A122-479).
- Ellis J., & Wulfek, W. (1986). Criterion-referenced measurement in military technical training. In J. Ellis (Ed.), *Military contributions to instructional technology*. New York: Praeger.
- Ellis, J. A., Wulfek, W. H., & Fredericks, P. S. (1979). *The instructional quality inventory: II. User's manual* (NPRDC SR m79-24). San Diego, CA: Navy Personnel Research and Development Center (AD A083-678).
- Ellis, J., Wulfek, W., Merrill, M., Wood, N., & Baker, M. (1979, April). *Empirical validation of selected instructional quality inventory prescriptions*. Paper presented at the American Educational Research Association convention, San Francisco.
- Hodak, G. W., Middleton, M. G., & Rankin, W. C. (1979). *Institutionalization of instructional systems development (ISD) in the Naval Education and Training Command: An organizational analysis* (TAEG Rep. No. 70). Orlando FL: Training Analysis and Evaluation Group.
- Kearsley, G. (1984). *Training and technology. A handbook for HRD professionals*. Reading, MA: Addison-Wesley.
- Lockhart, K. A., Sturges, P. T., VanMatre, N. H., & Zachai, J. A. (1979). *Computer-managed instruction in the Navy: IV: The effects of test item format on learning and knowledge retention* (NPRDC TR 81-8). San Diego: Navy Personnel Research and Development Center (AD A097-031).
- Merrill, M. D. (1983). Component display theory. In C. Reigeluth (Ed.), *Instructional-design theories and models: An overview of their current status*. Hillsdale, NJ: Lawrence Erlbaum.
- Merrill, M. D., Reigeluth, C. M., & Faust, G. W. (1979). The instructional quality profile: A curriculum evaluation and design tool. In H. F. O'Neil, Jr. (Ed.), *Procedures for instructional systems development*. New York: Academic Press.
- Middleton, M. G., Zajkowski, M. M., & Aagard, J. A. (1979). *The implementation of instructional systems development in Navy "C" schools: A needs analysis* (Tech. Mem. 79-1). Orlando, FL: Training Analysis and Evaluation Group.
- Montague, W. E., Ellis, J. A., & Wulfek, W. H. (1983, June). Instructional quality inventory: A formative evaluation tool for instructional development. *Performance and Instruction Journal*, 22(5), 11-14.
- Montague, W., & Wulfek, W. (1986). Instructional systems design. In J. Ellis (Ed.), *Military contributions to instructional technology*. New York: Praeger.
- Montemerlo, M. (1979). *The Instructional System Development Manual: Tool or tyrant*. Paper presented at the annual meeting of the American Psychological Association, New York, NY.
- Montemerlo, M., & Tennyson, M. (1976). *Instructional systems development: Conceptual analysis and comprehensive bibliography* (Tech. Rep. NAVTRA EQUIP-CEN IH-257). Orlando, FL: Naval Training Equipment Center.
- Nickerson, R. S. (1989). New directions in educational assessment. *Education Researcher*, 18, 9, 3-7.
- Semb, G. B., Ellis, J. A., Montague, W. E., & Wulfek, W. H. (1990). Self-paced instruction: Perceptions, pitfalls, and potentials. In T. Shlechter (Ed.), *Problems and promises in computer-based training*. Norwood, NJ: Ablex.
- Stern, H. W., & Fredericks, P. (1982). *Instructional quality inventory: Usability of procedures* (NPRDC TR 82-46). San Diego: Navy Personnel Research and Development Center (AD A117-681).
- Taylor, B. E., Ellis, J. A., & Baldwin, R. L. (1988). *Current status of Navy classroom training: A review of 100 Navy courses with recommendations for the future* (NPRDC TR 88-11). San Diego: Navy Personnel Research and Development Center.
- Vineberg, R., & Joyner, J. N. (1980). *Instructional Systems Development (ISD) in the armed services: Methodology and application* (HumRRO Tech. Rep. 80-1). Alexandria, VA: Human Resources Research Organization.
- Wetzel, C. D., Vankerkerix, D., & Wulfek, W. H. (1987). *Analysis of Navy technical school training objectives for microcomputer based training systems* (NPRDC PR 88-3). San Diego: Navy Personnel Research and Development Center.